



NEWSLETTER

Volume 19

Number 2

August 1981

Registered for posting
as a publication (Category B).



Volume 19 Number 2
August 1981

CONTENTS

Editorial.....	3
News and Views.....	4
1981 Conferences.....	7
Book Reviews.....	18
ABRS.....	23
AJMFR Contents.....	24
Article.....	25

AUSTRALIAN SOCIETY FOR LIMNOLOGY

The Australian Society for Limnology is an association of over 425 people with professional or amateur interests related to Australian inland waters. Since its inception in 1961 the Society has played an important role in fostering limnological work in this country. The ASL promotes liaison between limnologists in academic, private and governmental institutions and has a vested interest in the conservation of aquatic and related resources. Annual congresses are held near centres of limnological interest, and the programme includes scientific sessions, field excursions and social activities.

The ASL produces a *Newsletter* with notes on activities, articles of general interest, book reviews and congress announcements; a *Bulletin* of original scientific papers and occasional *Special Publications*. A further publication is the *Directory of Australian Limnologists*.

Membership applications are welcomed; four classes of subscribing membership are available:

Ordinary members	\$10.00 p.a.
Student members	\$4.00 p.a.
Institutional members	\$10.00 p.a.
Sustaining members	Fees on application

Members are entitled to receive the Australian Journal of Marine and Freshwater Research at the reduced rate of \$15.00 p.a.

Membership subscriptions cover the period 1 July to 30 June but subscriptions for Aust. J. mar. Freshwat Res. cover the period 1 January to 31 December.

Enquiries relating to membership should be addressed to:

Mrs. M. Hart,
Secretary, ASL.,
C/- Department of Chemistry,
Caulfield Institute of Technology,
P.O. Box 197,
Caulfield East, Victoria,
Australia 3145.

ASL Executive 1980-81

President: Frank Burns

Past-President: Sam Lake

Vice-President: David Mitchell

Secretary/Treasurer:
Margaret Hart

Committee:

The Officers of the
Society and:

Ian Campbell
Max Finlayson
Leighton Llewellyn
Luisa MacMillan
David Pollard
Phillip Suter
Robert White

Newsletter Editor:

R.W.G. White,
Department of Zoology,
University of Tasmania,
Box 252C, G.P.O.
Hobart, Tasmania,
Australia 7001.

EDITORIAL

In my report to the Annual General Meeting of the Society I recommended that the publication of the Bulletin should be terminated after the issue in hand. I made this recommendation for several reasons. Firstly, the supply of papers is inadequate to maintain a regular publishing interval. Secondly, I see little point in a research journal which is only distributed to the membership. And thirdly, there are many other journals already established in which to publish limnological work.

The A.G.M. disagreed with my recommendation and as Editor I accept this decision. I was not at the A.G.M. but I understand that the decision to continue with the Bulletin was supported by most members present. It is now up to these members to demonstrate their support for the Bulletin by submitting good quality papers. If the Bulletin is to become an established journal it must be published regularly and contain top rate papers. There is no future in a Bulletin coming out infrequently and irregularly and containing mainly papers which the authors think they couldn't get published elsewhere.

Robert White

NEWS AND VIEWS

A.S.L. Subscriptions

Accompanying this Newsletter is a request for your 1981/82 subscription. Please pay this promptly and so ease the load on our Secretary/Treasurer, Margaret Hart. Remember that if you wish to receive the Australian Journal of Marine and Freshwater Research in 1982 you must pay your augmented subscription before the end of the year.

D.Sc. for Ken McKenzie

Dr. Ken McKenzie, School of Applied Science, Riverina College of Advanced Education, Wagga Wagga, has just learned that his submission for the degree of D.Sc. has been accepted by the University of Western Australia. The title of the thesis was: "Ostracoda: and other small crustaceans". Congratulations, Ken!

Bicentennial History of Australian Science

The Australian Academy of Science is proposing to celebrate the bicentenary of Australia by publishing in 1988 one or more volumes dealing with the history of science and applied science in this country since 1788.

Individuals with an interest in aspects of the history of their science are invited to write to the Academy, to proffer manuscripts for possible publication, and more immediately, to signify any interest in attending a proposed conference on this subject in August 1982.

Inquiries to:

J.W. Swan,
Chairman,
Bicentennial History of Science Committee,
Australian Academy of Science,
P.O. Box 783,
Canberra City, A.C.T. 2601.

Eutrophication and Water Supply - Rabat, Morocco

This conference is organised by the International Water Supply Association. It will be held from 4 to 9 October 1981. Further information can be obtained from:

Organisation Committee of the Specialized
RABAT I.W.S.A.,
C/- Setude,
27 Boulevard des Italiens.
F-75002 Paris, France.

Third International Congress of Ecology - INTECOL

INTECOL's third congress will be held in Warsaw, Poland from 5-11 September 1982. At present, six plenary sessions are planned.

1. Processes integrating ecosystems and landscape.
2. Advancement in the understanding of organismal interactions in ecological systems.
3. Restoration and stabilisation of environmental quality.
4. Ecological basis of intensifying biological production.
5. Technological impact of man on environment.
6. Utilisation of ecological expertise in resource management and regional planning.

In addition, there will be a number of sessions organised by INTECOL Working Groups, including one on 'Aquatic Ecology'.

Further information from:

Organising Committee,
III International Congress of Ecology,
Institute of Ecology P.A.S.,
Dziekanow Lesny, 05-150 Lomianki,
Poland.

"Structures Affecting Fish Migration in Streams Draining the South Eastern Region of Australia"

This publication is part of the 'Ecology of Selected Estuarine Organisms' series released by the School of Zoology, University of New South Wales. It is authored by John Harris and consists mainly of two extensive tables detailing dams, weirs, roadcrossings, fords and causeways within the range of the Australian bass. Inquiries for copies of this useful publication should be sent to:

J.H. Harris,
School of Zoology,
University of N.S.W.,
P.O. Box 1,
Kensington, N.S.W. 2033.

Peter Rankin Trust Fund for Herpetology

The Committee of this Fund has recently invited applications for grants-in-aid. Further information from:

Director of Reptiles and Amphibians,
The Australian Museum,
P.O. Box A285,
Sydney South, N.S.W. 2000.

Australasian Society For Phycology and Aquatic Botany

The Australasian Society for Phycology and Aquatic Botany was founded at a meeting held at Monash University in May 1980. The objectives of the Society are:

a. Arranging, sponsoring or publishing specialist or general meetings or workshops for phycologists and aquatic botanists, or in areas of interest to phycologists and aquatic botanists.

b. The publication of a Newsletter which will be sent to all members of the Society.

The Secretary of the Society is Dr Bruce Allender of Monash University. The annual membership fees are: Ordinary Member \$12.00
Student Member \$4.00
Institutional Members \$100.00

1981 CONFERENCE

The Society maintained its drought-breaking run in New South Wales by bringing several inches of rain to Narooma between the 23rd and 25th of May. Whilst the regular conference goers reminisced about the Pooncarie Road and the previous New South Wales Conference at Menindee Lakes, those attending this year proved yet again that it takes more than three days of rain to dampen the indomitable spirits of 130 limnologists.

The 1981 Conference was held over three days, with papers on Saturday and Sunday and an excursion arranged for Monday. The standard of papers was extremely high, particularly from the students. The first student prize was awarded to Rod Oliver from the University of Adelaide, for his paper "A biological interpretation of phytoplankton photosynthetic production as a function of light absorbance".

Sam Lake gave the Presidential address, entitled "The resources boom, freshwater resources and limnology", and then donned his other hat to give the Jolly Award address, on the ecology of the macroinvertebrates of Australian upland streams - a review of current knowledge. This year, the Jolly Prize was awarded to Dr. John Kirk.

The Annual Dinner, held at the Hiway Motel, was as usual a riotous affair, but the social highlight of the weekend was undoubtedly the BBQ/Dance on Sunday night. The music could best be described as bush/punk; and the immediate Past President, having demonstrated his triple jointed knees on the dance floor, was heard to proclaim the need for someone to investigate the effect of punk music on invertebrate drift in streams.

After Sunday night, Monday could only be a let-down, and it was rapidly decided that a tour of the historic buildings of Tilba Village would be more intellectually uplifting for the membership than a BBQ on the Tuross River in the rain. The tour began with the enormously historically significant Dromedary Hotel.

In this issue of the Newsletter I have included those papers from the Alligator Rivers Symposium. Papers from the remainder of the Conference will be printed in the next issue.

R.W.

TEN YEARS OF ALLIGATOR RIVERS LIMNOLOGY - AN INTRODUCTION AND BACKGROUND TO LIMNOLOGICAL RESEARCH IN THE ALLIGATOR RIVERS REGION, 1971-1981.

D.A. Pollard, Environmental Studies, N.S.W. State Fisheries, Sydney.

I suppose that there's little need to point out to most of this audience where the Alligator Rivers Region is located, considering that quite a few of of the Society's members have worked there on and off over the past four years, and many of you would have heard the several papers presented on various aspects of the limnology of the area at the 1979 Congress. In fact, I think I presented the first paper to the Society on the Alligator Rivers Region (in which I discussed its fish fauna and the proposal for a major national park in the area) back at the 1973 Jameison Congress. However, ten years ago, when the first environmental studies in relation to the possible effects of future uranium mining in this area were being planned, few limnologists, let alone the general public, had ever heard of the Alligator Rivers Region. I certainly hadn't when I was approached by the Australian Atomic Energy Commission (AAEC) to carry out the original fish survey of the area and to assist in toxicity bioassay studies using local fish species in 1971. Since that time, of course, and particularly in the last four years, the Alligator Rivers Region has probably become the most intensely studied area, at least from the limnological point of view, in the whole of Australia.

The first environmental work related specifically to future uranium mining in the Region was initiated by the AAEC in late 1971 and most of the field work for this study was carried out during 1972. In addition to my fish survey of the area, which was concentrated on the Magela Creek catchment, Max Giles of AAEC organised and I helped him carry out the initial acute toxicity bioassay work on the effects of heavy metals on several species of fish from the area, and Des Davy and Neil Conway of AAEC carried out the original water quality studies in conjunction with the N.T. Water Resources Branch as part of this AAEC study. The results of these initial studies were published by the AAEC in 1974^(1,2,3).

A more extensive joint government-mining industry fact-finding study, which included projects ranging from hydrology to aboriginal art, was carried out during 1972 and 1973. Among these latter studies was Hamar Midgley's more wide-ranging fish survey of the Region, which also included tributaries of the East Alligator River system other than Magela Creek and parts of the South Alligator River system⁽⁴⁾. The overall results of this joint government-industry fact-finding study, including the AAEC work, were summarised in a review report published by the Commonwealth in 1977.⁽⁵⁾ One of the Society's early Presidents, the late John Lake, was a member of the Scientific and Technical Evaluation Committee for this joint fact-finding study.

With regard to the original fish surveys, between Hamar Midgley and myself we recorded 43 species of fishes from the freshwaters of the Region, and in the conclusion to my 1974 report I pointed out that:

...that section of the Magela Creek catchment within a 20 km radius of Mudginbarri station has a fish fauna of at least twenty-eight freshwater species (compared, for instance, with a total of twenty-seven native species present in the entire Murray-Darling system, the most extensive river system in Australia). The richness and diversity, and the scientific interest, of this ichthyofauna, as well as its importance for food and sport to Aborigines and other residents of the area, thus warrants the most careful consideration of any proposed changes in land use in the Alligator Rivers area.

(Actually, in the original draft I said "thus warrants the most stringent measures to protect it from the effects of any pollution resulting from future mining operations" but, presumably due to over-sensitivity on the uranium mining issue, this conclusion was changed to the somewhat meeker version above in the final printed report.)

In 1975 the Whitlam government initiated the Ranger Uranium Environmental Inquiry, which resulted in the now famous "Fox Reports", which also appeared in 1977. The first of these considered whether Australia should mine and sell uranium at all, and decided that it should, with certain "safeguards"⁽⁶⁾. The second Fox Report considered the environmental effects of mining in the Region, and among its recommendations included the creation of the Office of the Supervising Scientist for the Alligator Rivers Region (OSS) as a "watchdog" to oversee research and monitoring work aimed at minimising environmental degradation due to uranium mining and processing in the Region⁽⁷⁾. Such research and monitoring was considered particularly important as the greater part of the Alligator Rivers catchments surrounding the uranium ore bodies had been proposed as a major national park since 1965. This area, with the mine-sites excised, is of course now the Kakadu National Park⁽⁸⁾.

One of the first acts of the newly created OSS was to assemble a "Group of Experts" (all nine of whom could be loosely classified as limnologists) to advise on necessary environmental research in the Region. Because of the monsoonal climatic regime in this area and the nature of the potential mine wastes, the highest priority tasks of the Group of Experts were in the field of limnological research, and in fact over half of this Group was composed of Society members, including Bill Williams, Peter Tyler, John Skidmore, Barry Hart and myself. And, naturally enough, we recommended many of our colleagues and fellow Society members as having the most appropriate expertise to carry out the necessary research in this field. The results of research initiated by this Group of Experts and so far carried out have been summarised in the first two Annual Reports of the OSS^(9,10).

My particular task as a member of the Group of Experts was to plan and supervise an intensive ecological study on the freshwater fishes of the Region aimed at providing background information on the ecological requirements of those fish species and communities which could be affected by uranium mining in the Region. For this project we employed Keith Bishop and Sally Allen in 1978, and Keith will be presenting the results of our fish studies in the first talk in this Symposium. This general ecological study of the fishes having been completed last year (the results of which are in press with the

OSS and will be appearing shortly in the form of three very bulky reports,^(11,12,13) Keith is now concentrating on the problem of designing an ecological monitoring program for the area immediately adjacent to the Ranger mine site. Another project resulting from these fish studies which we would like to follow up, hopefully in collaboration with Walter Ivantsoff at Macquarie University, is to expand my 1974 account of the freshwater fishes into a more comprehensive field guide for the Region.

More recently the task of the Group of Experts has to a large degree been superseded due to the creation by the OSS of the Alligator Rivers Region Research Institute at Jabiru, the Director of which is Glen Riley; Doug Clay, a fellow fish ecologist, has recently been appointed as the Institute's Aquatic Biology Project Leader, and these two will act as Chairman for this morning's session.

As I mentioned before, some of the results of the limnological research sponsored and financed by the OSS and some of the mining companies and carried out in this Region have been presented at the Society's 1979 Congress, and also at two Workshops which were held at Jabiru in August 1978 and December 1979 and which some of you attended: the ten papers in today's Symposium will present further results from these studies.

REFERENCES

- (1) Pollard, D.A. (1974) - The freshwater fishes of the Alligator Rivers "Uranium Province" Area (Top End, Northern Territory), with particular reference to the Magela Creek Catchment (East Alligator River System). Australian Atomic Energy Commission, Sydney, Report E/305(1), 71 pp.
- (2) Giles, M.S. (1974) - Toxicity studies on aquatic organisms and grass sedge communities in the Magela Creek area. Australian Atomic Energy Commission, Sydney, Report E/305(2), 15 pp.
- (3) Davy, D.R. and Conway, N.F. (1974) - Environmental studies, Northern Territory Uranium Province 1971-73. Australian Atomic Energy Commission, Sydney, Report E305(3), 71 pp.
- (4) Midgley, S.H. (1973) - Freshwater fish inventory and associated habitat information. Alligator Rivers Region Environmental Fact Finding Study, Report to Department of the Northern Territory, 31 pp.
- (5) Christian, C.S. and Aldrick, J.M. (1977) - Alligator Rivers Study - A Review Report of the Alligator Rivers Region Environmental Fact-finding Study. Australian Government Publishing Service, Canberra, 174 pp.
- (6) Fox, R.W., Kelleher, G.G. and Kerr, C.B. (1977) - Ranger Uranium Environmental Inquiry, First Report. Australian Government Publishing Service, Canberra, 207 pp.
- (7) Fox, R.W., Kelleher, G.G. and Kerr, C.B. (1977) - Ranger Uranium Environmental Inquiry, Second Report. Australian Government Publishing Service, Canberra, 415 pp.

- (8) Australian National Parks and Wildlife Service (1980) - Kakadu National Park - Plan of Management. A.N.P.W.S., Canberra, 410 pp.
- (9) Supervising Scientist for the Alligator Rivers Region (1979) - First Annual Report 1978-79. Australian Government Publishing Service, Canberra, 146 pp.
- (10) Supervising Scientist for the Alligator Rivers Region (1980) - Annual Report 1979-80. Australian Government Publishing Service, Canberra, 148 pp.
- (11) Bishop, K.A., Allen, S.A., Pollard, D.A. and Cook, M.G. (1981) - Ecological studies on the fishes of the Alligator Rivers Region - summary report. Alligator Rivers Region Research Institute Research Report Series (Supervising Scientist for the Alligator Rivers Region, Sydney) (In press).
- (12) Bishop, K.A., Allen, S.A., Pollard, D.A. and Cook, M.G. (1981) - Ecological studies on the fishes of the Alligator Rivers Region - synecological studies. Alligator Rivers Region Research Institute Research Report Series (Supervising Scientist for the Alligator Rivers Region, Sydney) (In press).
- (13) Bishop, K.A., Allen, S.A., Pollard, D.A. and Cook, M.G. (1981) - Ecological studies on the fishes of the Alligator Rivers Region - autecological studies. Alligator Rivers Region Research Institute Research Report Series (Supervising Scientist for the Alligator Rivers Region, Sydney) (In press).

BIOLOGICAL UPTAKE AND TRANSPORT OF RADIUM IN AQUATIC ECOSYSTEMS

Alex. Williams, Environmental Science Division, A.A.E.C., Lucas Heights

The concentration factor model for radium uptake into organisms is tested for five different data sets, (algae, insects, fish flesh, mussel flesh and aquatic macrophytes). The model is found adequate for all except the fish flesh.

The implications for food chains of the concentration factors determined are noted. There being a decrease in accumulation with increased trophic level. The variance of the concentration processed increases with increased trophic level reflecting the mobility and diverse food sources of higher organisms.

Biological transport of radium by barramundi and water buffalo are considered, indicating the lack of equilibrium in the real system.

Vegetative recycling of radium from sediment to water column and also from the water column to sediment are discussed but their importances are unknown.

ECOLOGICAL STUDIES ON THE FRESHWATER FISHES OF THE ALLIGATOR RIVERS REGION

K. Bishop, N.S.W. State Fisheries, Sydney, N.S.W.

The Alligator Rivers Region of the Northern Territory has a tropical climate with a distinctive wet/dry cycle which results in seasonal flows in the creeks and rivers of its catchments. The present study commenced during June 1978 and was aimed to develop an ecological monitoring system that would detect changes in freshwater fish communities caused by recent uranium mining and processing in the lowlands of the Region. The broad objectives were

- To describe fish community structure at sites from a longitudinal array of habitats and show how the structure changes seasonally.
- To collect environmental and biological information on the sites and species, respectively, in use in interpreting changes in community structure.

A large matrix of information (sites x habitats x seasons x habitat structural and physico-chemical parameters x species x lengths x weights x gonad weights and stages x stomach contents and fullness x presence of macroparasites) was subsequently generated.

Distinctive fish communities were present in the upper reach Arnhem Land escarpment and the lower reach floodplain zones. These zones were major dry season refuge habitats for fish. The distinctiveness was most likely caused by substrate (including aquatic plants) preferences of some species and as a result allowed recognition of some migratory phases of fish between the escarpment and floodplains as wet season flows linked the zones across the lowlands. The community structure of the lowlands in the wet season depicted a flux between the latter two dry season refuges. The lowlands in the wet season were very important breeding and feeding areas. Fish movement in the Region was viewed as a classic response to temporal and spatial patchiness of resources.

INTRODUCTION: STUDIES ON *Velesunio angasi* - PART OF THE AQUATIC ENVIRONMENTAL PROGRAM AROUND THE URANIUM MINING VENTURES IN THE ALLIGATOR RIVERS REGION OF THE NORTHERN TERRITORY

Rod Simpson, Department of Zoology, University of New England, Armidale, N.S.W.

Velesunio angasi is currently being studied on three main topics.

- (1) Biology and ecology.
- (2) Natural levels of metals in tissues - fluctuations and variability; uptake of metals.
- (3) Uptake of radium-226.

These topics are covered by the next three following papers. The studies are inter-related in parts of their findings and goals. The goals include:

- (i) to obtain natural (baseline) levels of potential pollutants;
- (ii) to identify biological and ecological factors causing variability in (i);
- (iii) to assess the mussel as a possible biological monitor - in the

- sense of an early warning accumulator;
 (iv) to add data, for the mussel component, to the "dox limit" calculations for radium-226 in the human diet.

THE BIOLOGY AND ECOLOGY OF THE FRESHWATER MUSSEL, *Velesunio angasi* IN THE MAGELA CREEK, ALLIGATOR RIVERS REGION, N.T.

C. Humphrey, Zoology Department, University of New England, Armidale, N.S.W.

The biology and ecology of the freshwater mussel, *Velesunio angasi* in waterbodies of the Magela Creek, N.T. is presently under study.

The distribution and associated abundance of mussels, together with factors of possible influence, within and among billabongs are under investigation.

Quantitative mussel samples are collected monthly (diving) from seven billabongs and the Magela Creek bed (aestivating mussels over the dry season). In Georgetown, Mudginberri and Nankeen billabongs, mussels are sampled intensively by an air-lift operated by compressed air. Such sampling of all age-classes gives accurate estimates of recruitment, mortality and age structure - important parameters of mussel population dynamics. Buffalo billabong has been sampled by a mark-recapture method for additional information on mussel movements. Monthly mussel sampling from all waterbodies allows determination of densities and biomasses, and the size and age distribution relative to habitat and season.

Dark rings on the shells formed annually as a result of late dry season stresses, and observations of the growth of marked specimens are used to age mussels. Mussels commonly live to about 8-9 years. The size of mussels among billabongs show a similar ranking with the amount of primary productivity.

Routine examination of mussels and individuals of the fish species host to the glochidium (the parasitic mussel larva) shows that glochidia are produced and released year-round. However, glochidial production may be suppressed by prevailing water conditions, particularly the degree of stress imposed by oxygen and food (unicellular algae and detritus) depletions. Despite this breeding pattern, the major recruitment period of the juvenile, metamorphosed mussels is seasonal and lies between the wet and early dry seasons.

Twelve fish species have been identified (field and laboratory observations) as hosts of the glochidium, to date.

A two-phase annual cycle of condition of mussels (dry flesh weights) is evident with condition lowest in all billabongs prior to and after the wet season, but reaching peaks in the mid-dry and (to a lesser degree) during the early wet.

Further work envisaged is the examination of the gut contents of preserved mussels for dietary studies.

Proposed laboratory experiments will test the mussel's tolerance to desiccation, high water temperatures and anoxia - possibly important determinants of mussel distribution in the Magela Creek.

UPTAKE AND LOSS OF RADIUM-226 BY THE FRESHWATER MUSSEL, *Velesunio angasi*

R.A. Jeffree, Environmental Biology Section, Australian Atomic Energy Commission

Radium-226 is the most dangerous radioactive aquatic pollutant associated with uranium mining in the Northern Territory with respect to contamination of aquatic organisms used for human consumption. Freshwater mussels are known concentrators of Ra-226 and are also an important component of the traditional aboriginal diet.

The practical aim of this study is to provide data on rates of uptake and loss of Ra-226 in mussel flesh for predicted elevated radium-226 water concentrations and varying water concentrations of Ca and Mg that may also be modified by mining activities. In a more global sense, there are few studies of Ra-226 uptake in aquatic organisms and this study will hopefully elucidate the mechanism of accumulation.

Exposure of mussels for 28 days to 1500 mBq L⁻¹ Ra-226 and background water concentrations of Ca and Mg results in a 5-fold increase in Ra-226 tissue concentration, with no significant loss of Ra-226 during 28 days of exposure to radium-free conditions. For a similar Ra-226 water concentration and high water concentrations of Ca and Mg, there is no significant uptake of radium.

Exposure of mussels that are naturally high in Ra-226 tissue levels to radium-free conditions over 300 days results in no significant loss of Ra-226.

Studies of distribution of Ra-226 amongst tissues of *V. angasi* have shown that most is found in the visceral mass, with highest concentrations in the gills and palps. The relative distribution of Ra-226 amongst the tissues remains similar for field collected and laboratory exposed mussels.

Radium-226 shows a similar pattern of distribution amongst the tissues to the alkaline earth metals Ca, Mg and Ba. However this pattern of distribution is not specific to the alkaline-earth metals.

The nuclear track recorder, CR-39, was used to further investigate the sites of accumulation of Ra-226. Exposures of CR-39 to 5 μ sections of mussel tissue have shown that by far the highest densities of α tracks are associated with the inert granular deposits, with lower densities in the gills. Alpha spectrometry has indicated the presence also of the α -emitters U-234, U-238, Th-230, Pb-210, Po-210 and Po-218 in the granular deposits. Electron microprobe studies of the granular deposits to determine whether other alkaline-earth metals are present, have demonstrated high concentrations of Ca, P and Fe with lower concentrations of Ba, Mg, Mn and Al.

The location of Ra-226 and the other alkaline-earth metals in the granular deposits support the hypothesis that radium is accumulated as an analogue of calcium and/or magnesium. However all other α -emitters plus P, Mn, Fe and Al are also concentrated in the granules. If some of these other elements are regarded as analogues of Ca or Mg then the uptake mechanism for Ca or Mg must be rather indiscriminating.

HEAVY METAL ANALYSES IN *Velesunio angasi* - BASE LINE STUDIES AND NATURAL VARIABILITY

Helen Allison

Concentrations of thirteen elements (Al, As, Ca, Cd, Cr, Cu, Hg, Mg, Mn, Pb, Se, U, Zn and SO₄) have been measured bimonthly in the whole soft parts of the fresh water mussel *Velesunio angasi* from nine billabongs of Magela Creek, one billabong on Nourlangi Creek and one billabong on Coopers Creek, Alligator Rivers Region, N.T. Seasonal and between-billabong variation of the selected elements have been considered. Where possible, concentrations in the mussel have been related to that in the billabong water.

Individual variation has been minimised by consideration of particular size and sex, and voiding of the gut contents by purging the mussels in 1 µm filtered billabong water before analysis. Relative granule content of the soft tissues has been scored, as this may contribute to the variation. The abundance of these inorganic excretory granules is positively correlated with age.

Uptake of metals in the field is being investigated by transplanting mussels between billabong and into retention pond water of the Ranger Uranium Mine.

STUDIES OF THE PLANKTON OF THE MAGELA CREEK FLOODPLAIN, NORTHERN TERRITORY

R. Tait, Esso Australia Ltd., Rundle Project Group, P.O. Box 1189, Gladstone, 4680.

Studies of the phytoplankton, zooplankton and water quality of eight billabongs on the Magela Creek floodplain were carried out during 1979 and 1980. Data for Ja Ja billabong were presented in the paper, however, the correlations for all billabongs studied, were also presented.

Nutrient analyses were carried out, and it was found that ortho-phosphate was significantly correlated with chlorophyll-a, whereas nitrate-nitrogen was not, suggesting phosphate limitation of the phytoplankton.

Phytoplankton blooms were generally followed by peaks in zooplankton with the phytoplankton numbers remaining low during the zooplankton blooms.

Zooplankton numbers were found to be higher in the more turbid billabongs, with generally only two or three species present at the end of the dry season, with up to 25 species present during the early wet season (very low numbers of each species).

Total Organic Carbon peaked at the end of the dry season with the breakdown of vascular hydrophytes being the main cause. Particulate carbon and to a lesser extent phytoplankton, were the main food sources for the zooplankton.

The effects of the initial flushing of Ja Ja billabong at the beginning of the wet season were discussed. The introduction of acid water (pH down to 2.7), killed the zooplankton population completely.

COPPER COMPLEXING CAPACITY IN MAGELA CREEK WATERS AND IMPLICATIONS FOR ASSESSING TOXICITY.

B.T. Hart, Water Studies Centre, Caulfield Institute of Technology.

Trace metals in natural waters may exist in a number of physicochemical forms (speciation) that are determined by factors such as pH, redox potential, and types and concentrations of inorganic and organic ligands, and colloidal matter present. The speciation has a considerable influence on metal "bio-availability". Evidence now exists showing that the free ionic forms of several trace metals (e.g. Cu^{2+} , Cd^{2+}) are the most toxic forms to phytoplankton, invertebrates and fish. Complexed forms appear to be non-toxic or at least considerably less toxic than the free metal ions.

Most natural waters appear to have a capacity to reduce the toxic effects of added trace metals. This has been attributed to the complexation of the added metal by ligands (or colloids) present in the water, and is generally referred to as the "complexing capacity" of the water.

We report the results of an investigation to determine the copper complexing capacity of waters taken from the Magela Creek system in Northern Australia. There is considerable interest in this system because of the potential environmental impacts from the Ranger uranium mining and milling operations due to commence in 1981.

Filtered water samples taken from five Magela Creek billabongs during the 1979 dry season had copper-binding ligand concentrations in the range of 0.07 to 0.46 μM (4.4 to 29.2 $\mu\text{g Cu/L}$) and log conditional formation constants from 7.5 to 8.3 (pH 6.0). These were determined by an amperometric titration technique. The mean values were little different from those determined in samples taken during the 1980 wet season. Some unfiltered billabong waters had considerably higher complexing capacities due to the ability of the suspended solids to also bind copper. Two different types of suspended solids were identified and these varied markedly in their capacity to bind copper. The experimental data were used to calculate the concentration of free copper ions present in each water studied; these were remarkably similar (10^{-9} to 10^{-10} M at pH 6.0) and represented 5 to 10% of the filterable copper in each case.

TOXICITY STUDIES ON FISH IN THE ALLIGATOR RIVERS REGION, N.T.

Lynn Baker, Office of the Supervising Scientist, Post Office, JABIRU EAST, N.T. 5796.

The Office of the Supervising Scientist during 1980, set up toxicity testing facilities to carry out bioassays using local fish species, at its Jabiru field station. Information gained will help establish 'safe' metal concentrations for the A.R.R. waters, in event of seepage or a necessary release of contaminated water from a uranium mine site. Initial research has been directed towards obtaining acute or short-term lethal concentration values (96hrLC_{50}) for relevant heavy metals with a number of fish species.

Bioassays were run according to A.P.H.A. (1975) and E.P.A. (1978) standard methods. The tests were static and conducted with 30 micron filtered billabong

water. The test temperatures were set at 27 ± 1 degree C. Fish were netted from Magela and Nourlangie Creeks and stored in bore water until required for testing. Five days prior to testing they were transferred to billabong water at the set temperature.

Zinc bioassays were carried out from November, 1980 to April, 1981 for three fish species. 96hrLC50's with 95% confidence intervals were estimated, in duplicate, by the Litchfield and Wilcoxon Nomograph Method, 1949.

FISH SPECIES	ZINC CONCENTRATIONS (ppm)
checkered rainbow fish (<u>Melanotaenia splendida</u> <u>rubrostriata</u>)	6.2 $\pm$ 1.2; 4.8 $\pm$ 0.9
black-striped rainbow fish (<u>M. nigrans</u>)	12.6 $\pm$ 3.3; 6.8 $\pm$ 0.5
fly-specked hardyhead (<u>Craterocephalus</u> <u>stercusmuscarum</u>)	<1.0; 0.6 $\pm$ 0.5

Changes in size and gonadal condition of fish were recorded and possibly contribute to variation in the above values. Water quality remained reasonably constant. The billabong water was very soft with total hardness of 11.4 $\pm$ 5.7 mg/L, while the bore water was a factor of 10 harder. The zinc concentrations in the billabong water was <0.02 ppm and 0.19 ppm in bore water. Zinc levels were measured as total zinc by flame A.A.S. but approximate labile zinc as the billabong water has very low complexing capacity at the zinc concentrations used.

Research will continue using other metals and further work on chronic bioassays is envisaged. The possibility of converting to flow-through testing, and implementing a fish breeding programme is being investigated.

TRACE METAL CONCENTRATIONS IN ABORIGINAL FOOD FISH

Johy Bywater, Ranger Uranium Mines

One aspect of the current Ranger Uranium Mines Pty. Ltd. agreed environmental programme is to measure levels of the potentially toxic trace metals cadmium, copper, lead, manganese, zinc and uranium in fish species from the Ranger Project Area. Programmes of this type are designed with the primary objective of ensuring that the public is not exposed to undesirable levels of these metals. The most vulnerable group potentially exposed to contamination from fish are Aboriginals. In the recent study, emphasis is placed on analysis of Aboriginal dietary fish species.

Fish species being sampled for trace metal analysis are: barramundi (Lates calcarifer), saratoga (Scleropages jardini), salmon catfish (Hexanemataichthys leptaspis), sleepy cod (Oxyloetris lineolatus), long tom (Strongylura krefftii), and bony bream (Nematolosa erebi).

Selection of these fish was made on the advice of resident Aboriginal informants.

BOOK REVIEWS

WATER QUALITY CRITERIA FOR FRESHWATER FISH

J.S. Alabaster and R. Lloyd. 297 pp. Butterworths, London (Australian Agents: Butterworths, P.O. Box 586, Chatswood, N.S.W. 2076). Recommended price \$49.50. Price per page: 16.7¢.

Reviewed by E.A. Scribner

This book is a collection of updated technical reports, previously published individually by the European Inland Fisheries Advisory Commission (EIFAC).

The subject matter makes it more likely to be used as a reference than a text. The user might perhaps be a student working on an assignment, a biologist answering a query from the public, an administrator deciding what conditions should be written into a regulation governing discharge of wastes, or an industrial employee trying to anticipate or negotiate such a regulation.

Water quality criteria for freshwater are usually made with use for public water supply, irrigation or industry in mind. However this book is about water quality for fish and considers requirements for aquaculture and more importantly maintenance of natural aquatic life.

It should be clearly understood that this book is applicable primarily to conditions in Europe and the fish dealt with are largely European fish. The general approach has been to consider criteria for salmonids and criteria for so-called coarse fish, which are apparently all other fish. As one might expect, salmonids are usually more sensitive. On the basis of our limited knowledge of Australian native fish, I would tend to place them in the coarse fish category. In doing this it must be borne in mind that there are virtually no data for the effects of pollutants or altered physico-chemical parameters on these fish, and not very good reasons to assume that they would naturally have similar stress tolerances to European native fishes. This does not represent a failing in the book of course, but it does impose a limit to its usefulness in Australia.

The parameters and pollutants covered are temperature, pH, finely divided solids, dissolved oxygen, ammonia, chlorine, phenols, zinc, copper and cadmium. While the six pollutants are of undoubted importance, they do not

necessarily represent the most important, although where to draw the line is quite difficult. The major Australian work on water quality criteria, that of Barry Hart ("A Compilation of Australian Water Quality Criteria", Australian Water Resources Council Technical Paper No. 7, 1974) lists 43 parameters for discussion. Some that are worthy of inclusion in a book on water quality for fish are detergents, dissolved solids (salinity), iron and manganese, mercury, oil and oil dispersants, pesticides and PCB's.

Because of the wide variety of different bioassay techniques employed in fish toxicity and tolerance studies, it is difficult to make a literature review highly systematic. The system employed in this book is very good, with a well-ordered hierarchy of headings and sub-headings, but it is light on tables preferring rather to give prose summaries which are considerably more tedious to assimilate. However, many readers will only be interested in overall conclusions and recommendations. These are easy to find, as the last section of each chapter is titled "tentative water quality criteria", and in many cases are summarised in a table.

The setting of legal standards is perhaps the most important use to which this book might be put, as it is concerned with the effects of pollution by human agencies rather than by natural causes. Consequently, criteria should be manageable through legislation and law enforcement. The New South Wales Clean Waters Act and equivalent legislation in other States specifies limits in effluent discharges to water quality parameters or to pollutant concentrations. These have been largely derived from overseas documents pertaining to town water supplies. In the instances where the welfare of fish puts additional constraints on water quality, as evidenced by criteria proposed in this book, a case exists for the incorporation of these constraints into state legislation. Unfortunately, there are areas of conflict between conservation and public health interests and, in these, public health usually has priority. Thus, chlorine is still used for disinfection of sewage effluents, and the resulting concentration in receiving water may exceed the (virtually unmeasurable) concentrations recommended in this book. Copper sulphate continues to be used as an algicide in town water supply reservoirs, vastly exceeding the criteria proposed for fish, and sometimes resulting in fish mortality.

Despite the drawbacks mentioned above this book could be considered essential for all organisations involved in water quality management. The amount of literature in the field of fish toxicity and tolerance is huge, as evidenced by the lists of references at the end of each chapter, and this book provides

a comprehensive survey. It may also serve to heighten awareness, in the areas where decisions are made regarding allocation of funds for research proposes, about how little data on toxicity and stress tolerance are available for Australian native fish.

THE ECOLOGY OF STREAMS AND RIVERS

C.R. Townsend. 68 pp. Institute of Biology Studies in Biology No. 122. Edward Arnold (Publishers) Ltd., London. Paper covers: \$6.50, Price per page: 9.5¢.

Reviewed by P.S. Lake

Up till now, there have been no reviews of stream ecology suitable as textbooks for undergraduate students. In the standard textbooks of limnology the emphasis is lentic, though one or two chapters on lotic systems may be present. Comprehensive reviews such as Hynes' "The Ecology of Running Waters" and Whittton's "River Ecology" have sections and chapters to which the undergraduate can be referred but they are not textbooks - they were not designed to be. Townsend's short book is an attempt to fulfil this heuristic need but I am afraid that because of its brevity it is only partly successful.

The title of the book promises more than can be delivered in the short space of 68 pages. Once one has realized that the book is selective in the aspects of lotic ecology that are covered, then there is no doubt that the aspects of lotic ecology that are dealt with are presented in a stimulating and lucid way. For the author is concerned with "questions of spatial distribution in the lotic ecosystem" and the book does not "dwell on primarily temporal phenomena such as life histories and population dynamics". Such an emphasis means that a lot of current concern in lotic ecology is not mentioned and that processes of great impact in population dynamics such as competition and predation can only be cursorily covered.

On the theme of spatial distribution of variables and biota in lotic ecosystems, the book is a stimulating review. Hopefully it may provoke some students to consider seriously some of the problems of spatial distribution in streams - an unfashionable area of study in this part of the world where the elucidation of individual life histories or in the correct jargon "Life history strategies" is paramount. The arrangement of the exposition on spatial dis-

tribution is a logical and sound one.

The book begins with a brief outline of the biota of lotic ecosystems which is followed by a succinct coverage of the physico-chemical variables of the flowing water environment. Chapter 3 "Longitudinal Pattern in the Distribution of Organisms" no doubt was the most difficult to write, for in it the author brings together a variety of approaches that have been used to elucidate why particular taxa are found in particular parts of a river - a difficult question. The fourth chapter deals with the movement of energy in lotic ecosystems and is a useful account of stream energetics though the role of periphyton production, an energy-trapping pathway which as Minshall has pointed out has been greatly overlooked, is understated. The last two chapters "Microdistribution Patterns" and "Benthic Community Dynamics" are for me, the best parts of the book. Hopefully the words of advice on the bottom of page 51 will be heeded by budding lotic ecologists. The opening statements of Chapter 6 which stress the continuous flux in spatial patterns in a river are most pertinent. Lotic communities differ from most communities beloved by theorizing community ecologists - in that as opposed to intertidal communities, tropical rain forests and coral reefs, most things in lotic systems, be they animals' food or substrata, are moving continually. In a sense the system is being continually perturbed and yet, within the relatively small living space of rivers, there is a great diversity of invertebrates and vertebrates. It is in the account of drift that the only Australian work - that of Cadwallader and Eden is cited. It is perhaps a pity that the other paper on the effects of the total eclipse on invertebrates drift by Suter and Williams is not mentioned.

The book is stimulating in that the author on numerous occasions points out the great gaps in our knowledge of lotic ecosystems. Understandably the book is written from a Northern Hemisphere perspective and it serves to highlight the sad situation of lotic ecology in Australia, for we have still to find out what lives in our streams let alone attempt to elucidate the factors controlling the spatial distribution of our lotic fauna.

The book does highlight the view that lotic ecosystems provide "an admirable medium for fundamental ecological research" and it will serve as a most useful reference text for any course in freshwater ecology. As it is a cohesive account of the contemporary situation in some aspects of lotic ecology, it is recommended to the practicing stream ecologist. The book is written in a most accessible style and as far as I could detect, it is free of errors -

author's, publisher's or printer's.

In U.K. the book costs £2.50 or, as on 7 July 1981, A\$4.18 - expensive yet reasonable. But it seems to be a very expensive business - importing paperbacks from U.K. - for in Australia the book sells at A\$6.50. Hardly a price to attract undergraduates or the new persecuted poor of Australia - postgraduate students.

ABRS

Ian Campbell writes:

"The Australian Biological Resources Study (ABRS) was established in 1977 to make recommendations on the conduct - in the longer term - of taxonomic and ecological studies and the housing, maintenance and display of national scientific collections, and to provide financial assistance to work in these fields.

The study is administered by a director advised by a committee appointed by the Minister for Science (now the Minister of Home Affairs and the Environment? - Ed.), and operates as follows: Individuals are invited to register their interests in participating in the program, and nominate the groups or organisms in which they are interested. The ABRS periodically nominates selected groups as preferred groups for study. For example, the listing for 1982 includes - Turbellaria (fresh water) Trematoda, Qstracoda Pericardia, larval Moscoida, and so on. All those with an interest registered in these groups are then invited to submit project outlines, which are then considered by the advisory committee, who select some for funding.

I have been concerned, both at the relatively small proportion of ABRS funds directed to the taxonomy of the freshwater biota, and also that the groups which ABRS has selected as priority groups within the freshwater biota were not those which are of concern to most of the limnologists with whom I have contact. As a result of my correspondence expressing these views, Dr. Richardson wrote to me suggesting that the ABRS would be pleased to receive recommendations on priority groups from scientific organisations such as ASL.

At the last AGM, Sam Lake and I volunteered to prepare a set of recommendations on behalf of the Society. To that end, I am appealing to members to write and let me know which groups of freshwater organisms you believe are most in need of taxonomic study in Australia, and why. I hope that Sam and I will have a tentative list of priority groups ready for the next Newsletter, and we shall then invite further comment before submission to the ABRS.

Please send your suggestions to the address below:

I. CAMPBELL,
Water Studies Centre,
Caulfield Institute of Technology,
P.O. Box 197,
CAULFIELD EAST, Vic. 3145 AUSTRALIA

AJMFRC CONTENTS

Contents Volume 32 Number 2 1981

Distribution and significance of copper, lead, zinc and cadmium in the Corio Bay ecosystem. *J. David Smith, Edward C.V. Butler, Bruce R. Grant, Gregory W. Little, Nancy Millis and Peter J. Milne* 151

Ecological effects of mine effluents on the South Esk River, north-eastern Tasmania. II. Trace metals. *R.H. Norris, R. Swain and P.S. Lake* 165

Trace metal speciation in three Victorian lakes. *Barry T. Hart and Simon H.R. Davies* 175

Life histories of benthic invertebrates in a kauri forest stream in northern New Zealand. *D.R. Towns* 191

Use of catchability equations for population estimation of marron, *Cherax tenuimanus* (Smith) (Decapoda : Parastacidae). *N.M. Morrissey and N. Caputi* 213

Benthic communities in an estuary with periodic deoxygenation. *S.F. Rainer and Rachel C. Fitzhardinge* 227

Carbon and nitrogen content of food and the assimilation efficiencies of penaeid prawns in the Gulf of Carpentaria. *D.J.W. Moriarty and M.C. Barclay* 245

Revision of Australian species of *Branchinella* (Crustacea : Anostraca). *M.C. Geddes* 253

Short Communication

Biomass method for measuring productivity of *Echlonia radiata*, with the potential for adaptation to other large brown algae. *E.H. Mann and H. Kirkman* 297

ARTICLE

This article was submitted by Brian Timms of Avondale College. Brief articles, on any topic related to the interests of the Society, are always welcome.

R.W.G.W.

DRIFTING SANDS, DUNE LAKES AND SAND MINING

B.V. Timms, Sciences Department, Avondale College, Cooranbong, N.S.W. 2265

During the late 1960's and early 1970's the very existence of some coastal dune lakes in southeast Queensland was threatened by mineral sand mining. That these lakes remained in their pristine state was due largely to study and representations by Ian Bayly (e.g. Bayly, 1974) and dedicated laymen like John Sinclair. One would have thought the issue was closed, but during the last year there have been many press reports of Queensland politicians and others advocating a recommencement of mineral sand mining, especially on Fraser Island. It would seem that this would involve those leases near to/including the previously threatened lakes.

While the Fraser Island Environmental Enquiry was very forthright on the threat to dune lakes from pollution and hydrological disturbance, it hardly mentioned the possibility of sand from exposed areas blowing into the lakes and infilling them. Certainly Ian Bayly submitted to the Enquiry that natural sand infilling would be exacerbated by mining near Lake Wabby. I feel, mainly from evidence in northern N.S.W., that infilling of lakes by sand from mining areas is a greater possibility than previously considered and should be cited as a further reason for not mining near dune lakes.

Firstly it should be realised, as Ian Bayly submitted to the Enquiry, that those lakes near active dunes are slowly being reclaimed naturally by advancing sand fronts. According to John Sinclair (1977 and personal communication) the dune front at Lake Wabby is advancing into the lake by 0.4 m a year; at such a rate the lake will be obliterated within decades. From my experience Blue Lagoon, in the Red Rock National Park near Woolgoolga, northern N.S.W., is in a similar position, but the rate of dune advance seems to be much slower.

Such lakes are exceptions among dune lakes, as all others in northern-

N.S.W.-southern Qld have well vegetated and stable environs. Should, however, sand near the lake be stripped of its binding vegetation, it could blow grain by grain into the lake. I believe that this is also happening naturally in Blue Lagoon. On one occasion I visited the lake after a strong southerly blow, and noticed that the thick beds of Chara which clothe much of the lake bed were gritty to touch because of adhering sand grains (mainly of SiO_2). Presumably these had come from the adjacent bare dunes and eventually would fall to the floor of the lake.

While no data are available on this process in the three N.S.W. dune lakes that were close to mining operations¹, there is unequivocal evidence that some streams have been shallowed by sand accretion from adjacent exposed dunes. One documented case is Cudgen Creek near Kingscliff. There Roy (1975) showed that 'the lower reaches of Cudgen Creek have silted up in recent times mainly due to wind erosion of adjacent dunes mined for heavy minerals'. He furthermore recommended the 'rehabilitation of the coastal dune surfaces to prevent wind erosion of mined areas' as the 'main preventative measure ... to combat siltation in Cudgen Creek' and stated that 'companies mining the adjacent dunes should be encouraged to restore the vegetation cover as quickly as possible'. The lesson for dune lakes in southeastern Qld. and elsewhere is obvious - sand should not be exposed near lakes. On Fraser Island sand movement by wind is likely to be even more of a problem than in northern N.S.W. because of the generally stronger and more constantly directional southeast winds.

This threat to dune lakes from sand mining operations is not as great as the two highlighted in the Fraser Island Environmental Enquiry. Either of the latter could destroy a lake, whereas sand accretion would probably only shallow a lake before remedial action was taken. The effects of such modification of already shallow lakes are largely unknown. I do know, however, that different benthic communities live on sandy and muddy substrates in dune lakes. Even any minor modification would be intolerable in lakes so scientifically unique and aesthetically outstanding.

¹ Two frontal dune ponds were completely reconstituted (Timms, 1977) while Taylors Lake, in an interbarrier swale is now estuarine because the weakened foredune has subsequently been eroded (Timms, 1978).

References

- Bayly, I.A.E. (1974). Fraser Island's special claims. *Aust. Cons. Found. Newsl.* 6(3): 3-4.
- Parliament of the Commonwealth of Australia (1976). Fraser Island Environmental Enquiry. Parliamentary Paper No. 333/1976.
- Roy, P.S. (1975). Coastal Geology of the Cudgen Area, North Coast of New South Wales. *Rec. geol. Surv. N.S.W.* 17 (41-52).
- Sinclair, J. (1977). "Discovering Fraser Island". Pacific Maps: Surrey Hills.
- Timms, B.V. (1977). Man's influence on dune lakes. *Hunter Natural History* 9: 132-141.
- Timms, B.V. (1978). The demise of Taylors Lake. *Aust. Soc. Limnol. Newsletter.* 15(2): 20-22.

